Searching long-lasting phosphor at 385 nm

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The objective of the present work is the synthesis of phosphors with long time emission in the wavelength range near 385 nm [1].

The effective photocatalytic oxidation reaction of the organic matter on TiO_2 requires a radiant energy contribution with a wavelength near 385 nm in the nearby U.V. with mixtures of anatase and rutile phases. The TiO_2 is widely used in environmental decontamination such as in the treatments of pesticides or water [2].

Recent works [3,4] show that is possible to make the synthesis of the materials sought (host) but these must contain Ce^{3+} as doping. The desired issuance is observed in the U.V. and it is attributed to the transition 4f→ 5d of Ce^{3+}. This emission is produced in a matrix formed by tetrahedra of AlO_4 and SiO_4, which plays an important role in creating the holes-trap responsible for the phosphorescence.

In the present work the composition of the synthesised samples has been planned by means of a design of experiments, and it was based in the following general formula:

$$(Sr_{1-v}M_v)_{1+y}\ Al_{2-x}\ B_x\ Si_y\ O_{4+3y} :n\ Ce^{3+}\ (M= Ca, Mg, Ba)$$

The samples were obtained by solid phase reactions in a tubular furnace with reducing atmosphere to prevent oxidation of Ce^{3+} to Ce^{4+}. B_2O_3, which acts as melting agent, was introduced in the synthesis step in order to reduce the temperature of synthesis necessary to obtain the compound; in the case of $SrAl_2O_4$ the synthesis temperature is 1400ºC.

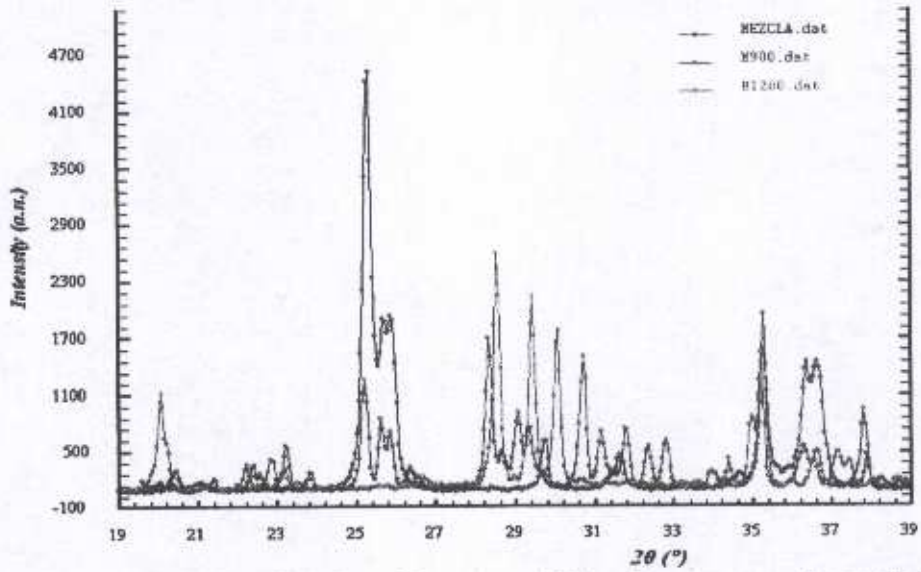

Figure 1. The XDR diffraction diagrams obtained over several samples.

The crystallographic and spectroscopic study on the different samples prepared has been carried out. Some XRD diffraction diagrams obtained are shown in the Figure 1.

Several formulations including different amount of melting agent were prepared in order to determine the temperature of synthesis. A synthesis temperature of 1200ºC was found, as can be observed in the Figure 1. The same synthesis was performed in reducing atmosphere, using Ce^{3+} as doping element.

Fluorescence spectrometry measurements have been performed over the synthesised compounds; the samples were illuminated with a xenon flash lamp and the time evolution of the emission spectrum was studied (see Figure 2).

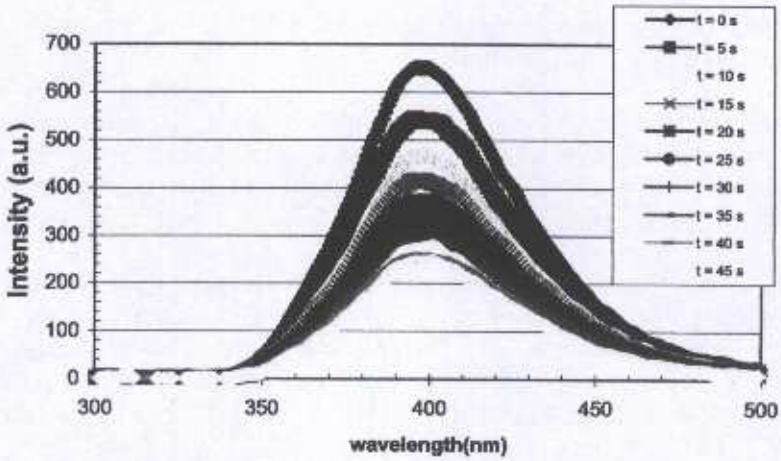

Figure 2. The temporal evolution of the emission spectrum of $Sr_2Al_{2-x}B_xSiO_7$:n Ce

The issuance measurements of these samples present wide bands of luminescence whose intensity increases with the time of irradiation, with peaks below 400 nm and a persistence of nearly 2 min. Only phosphorescence is observed in the silicated and calcined samples in a reducing atmosphere, suggesting that the presence of silica in the network is critical to the emergence of persistent phosphoresce. The maximum wavelength reached in all of them is between 390 and 405 nm, which is higher than that sought of 385 nm, and hence the energy is lower than that needed in the photolysis.

References

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